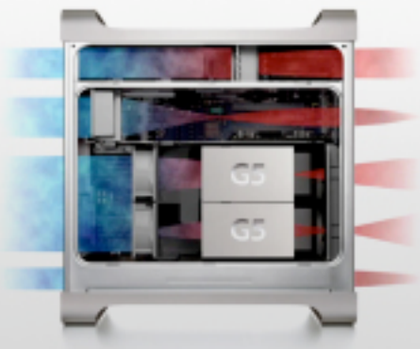
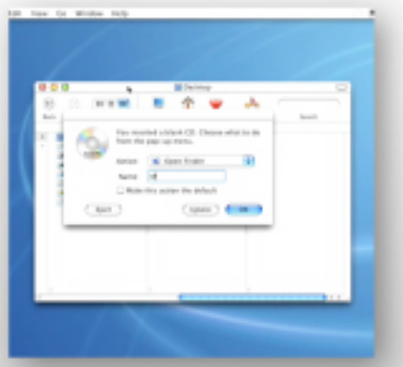
Developing With FireWire 800

Session 504





Developing With FireWire 800

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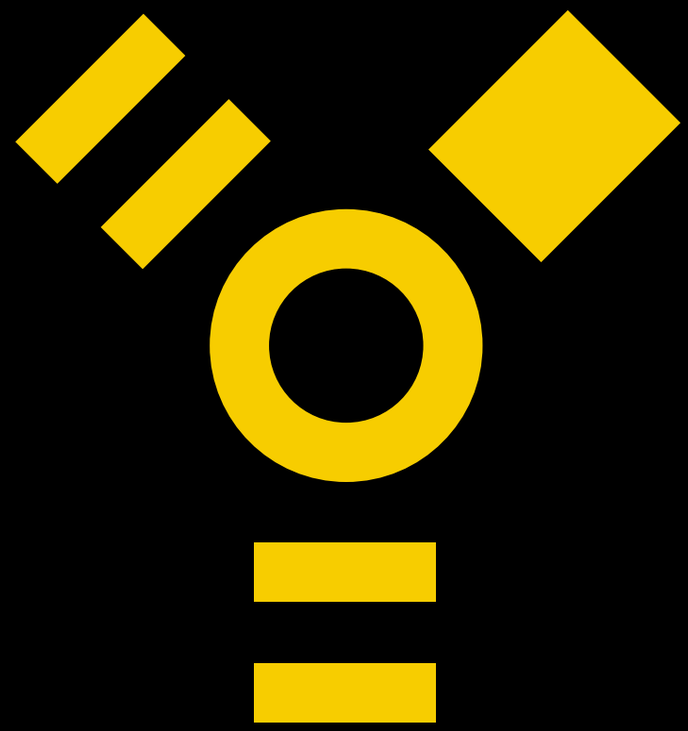
Introduction

This session is about FireWire 800

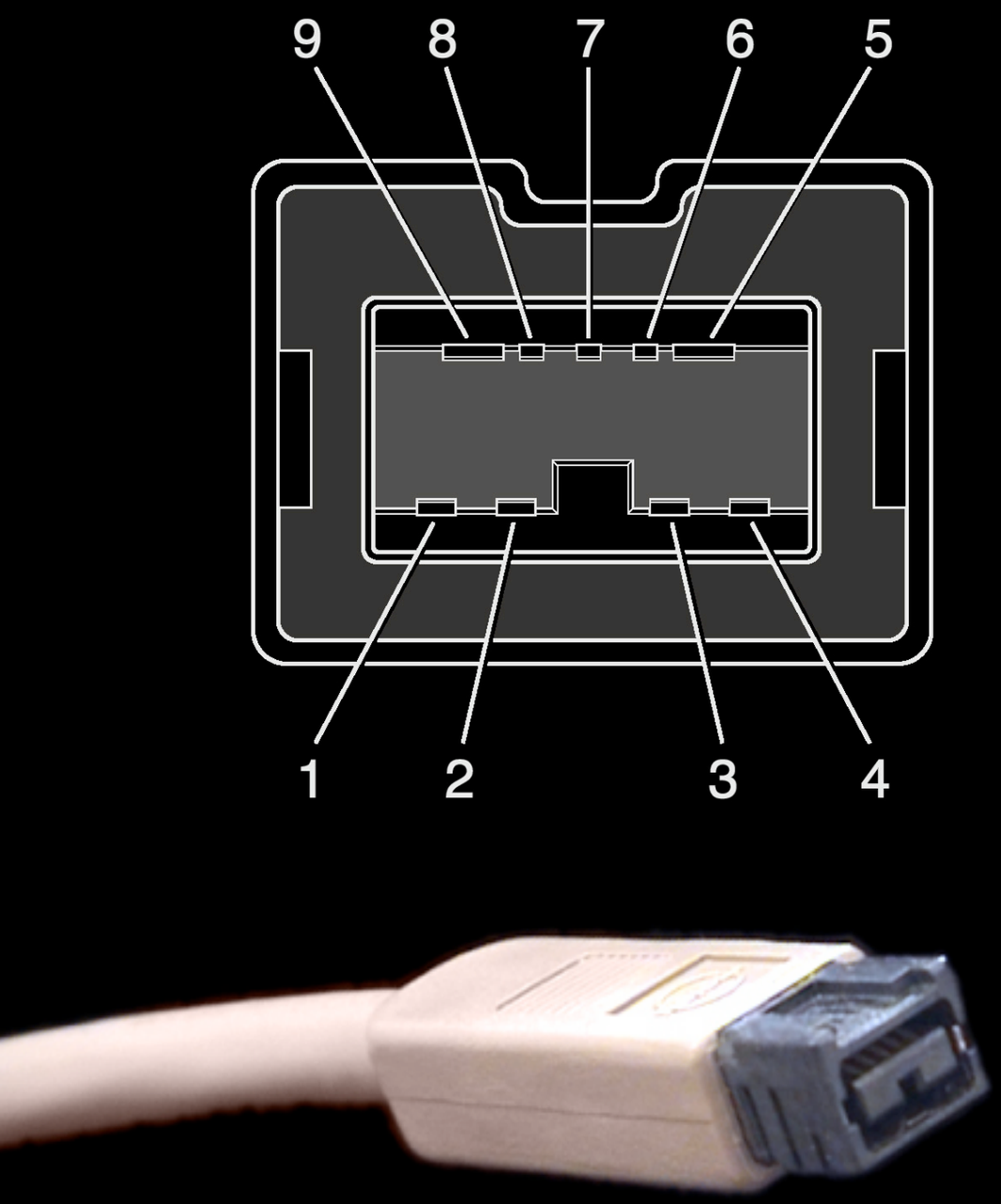
- How Apple has deployed this technology
- How to use FireWire 800 in your hardware and software products
- Impact of FireWire 800 on existing FireWire products



What You Will Learn

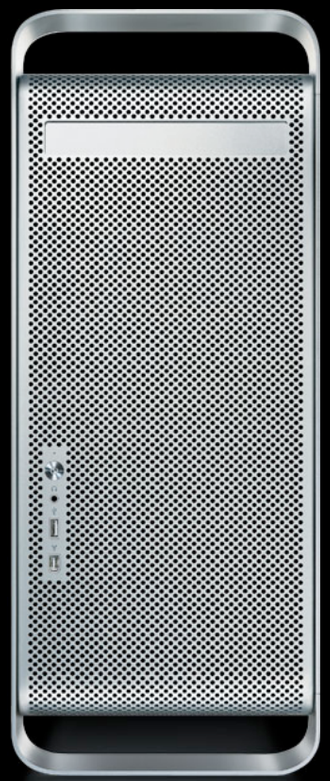
- What is FireWire 800 and how does it work?
- Developing FireWire 800 hardware
- Developing FireWire 800 software
- Developer resources
- New FireWire tools

What Is FireWire 800?



FireWire 800

- New connector
  - 9-pins for higher speeds
  - Backwards compatible
- Higher speed
  - 2x as fast as FireWire 400
  - More efficient
- Greater distance
  - Up to 100 meters
  - Various media options



Products

- Power Macintosh G5
  - FireWire 800 x 1
- 17-inch PowerBook G4
  - FireWire 800 x 1
- Xserve
  - FireWire 800 x 2

- All have FireWire 400 too

FireWire 800 In Detail

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First: What Has Not Changed

- Same…
  - Point-to-point connection model
    - But now tolerates loop
  - Peer-peer operation
  - User friendliness—plug and play
  - Transaction and addressing models
  - Asynchronous and isochronous operation model
- Identical functionality above the link layer
  - Existing software will work unchanged

What Is FireWire 800, Really?

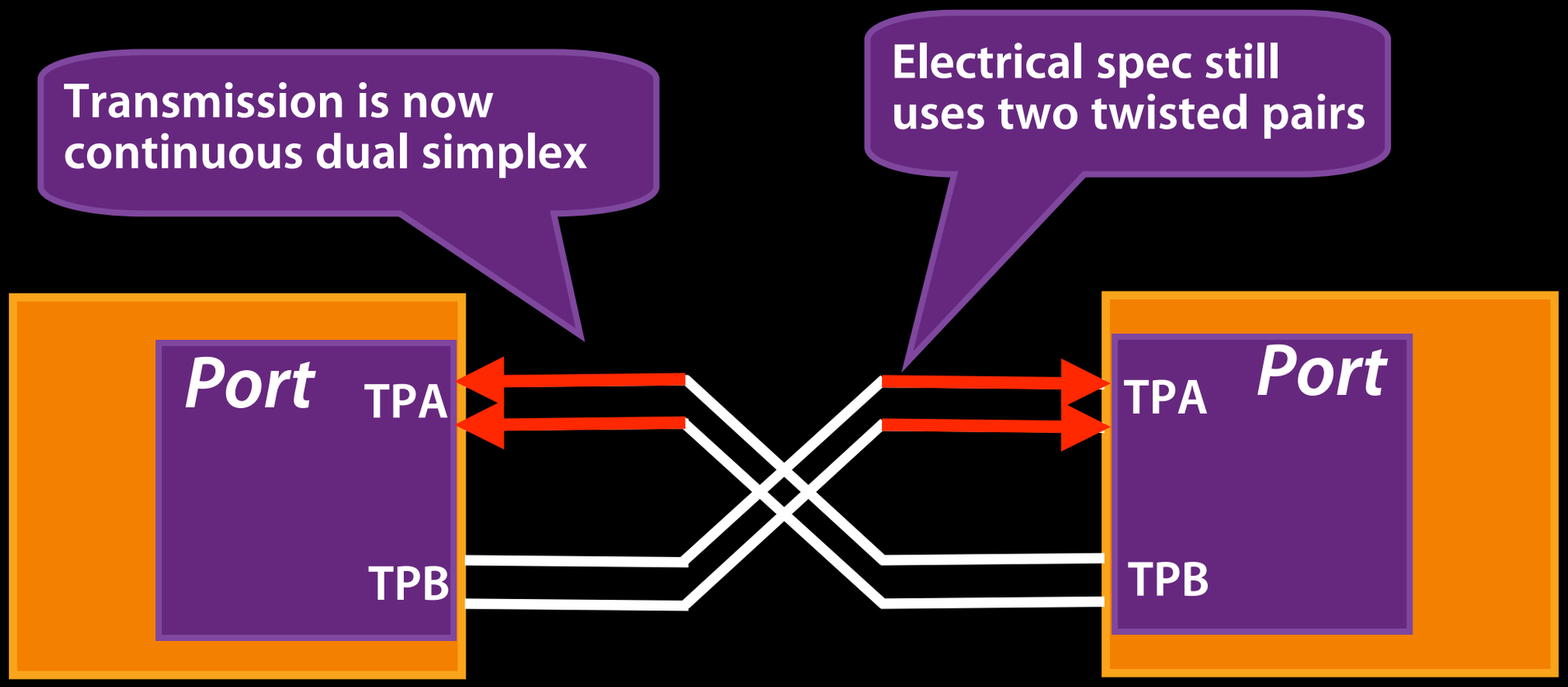
- Apple's name for S800 Bilingual IEEE 1394b
  - S800 means 8 times faster than S100
- Additional Beta mode of operation
  - 1394a operation is called Legacy mode
- 1394b PHYs may have Legacy ports, Beta ports, or Bilingual ports
  - Bilingual ports negotiate with attached peer for best mode of operation (Beta is MUCH better)
- Beta mode yields higher speeds, longer distance, improved efficiency, better user experience

Beta mode:

Higher Speeds

1394b specifies S800 and S1600 data transmission rates

- Future-proofs with media for S3200

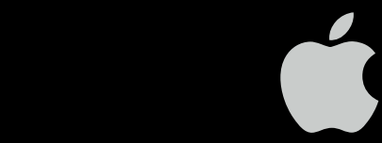


One pair transmitting continuously in each direction
Transmission speed never varies
Simpler and more efficient than 1394-1995

Beta mode:

Signal Encoding

- All signaling uses 10 bit symbols
- Data and arbitration states use IBM's 8B10B encoding
  - Leveraged from Fibre Channel and Gigabit Ethernet
  - …but scrambled to minimize emissions
- Control symbols use 10 bit codes
  - All DC balanced with a Hamming distance of 2 from each other and from data for added robustness
  - Also scrambled



Beta mode:

Signal Encoding (Cont.)

- Shorter start and end packet times
  - No packet start-up latency
- Same coding scheme for all media
  - Ideal for optical transmission
  - Leverage the benefit of high volume production for PHYs

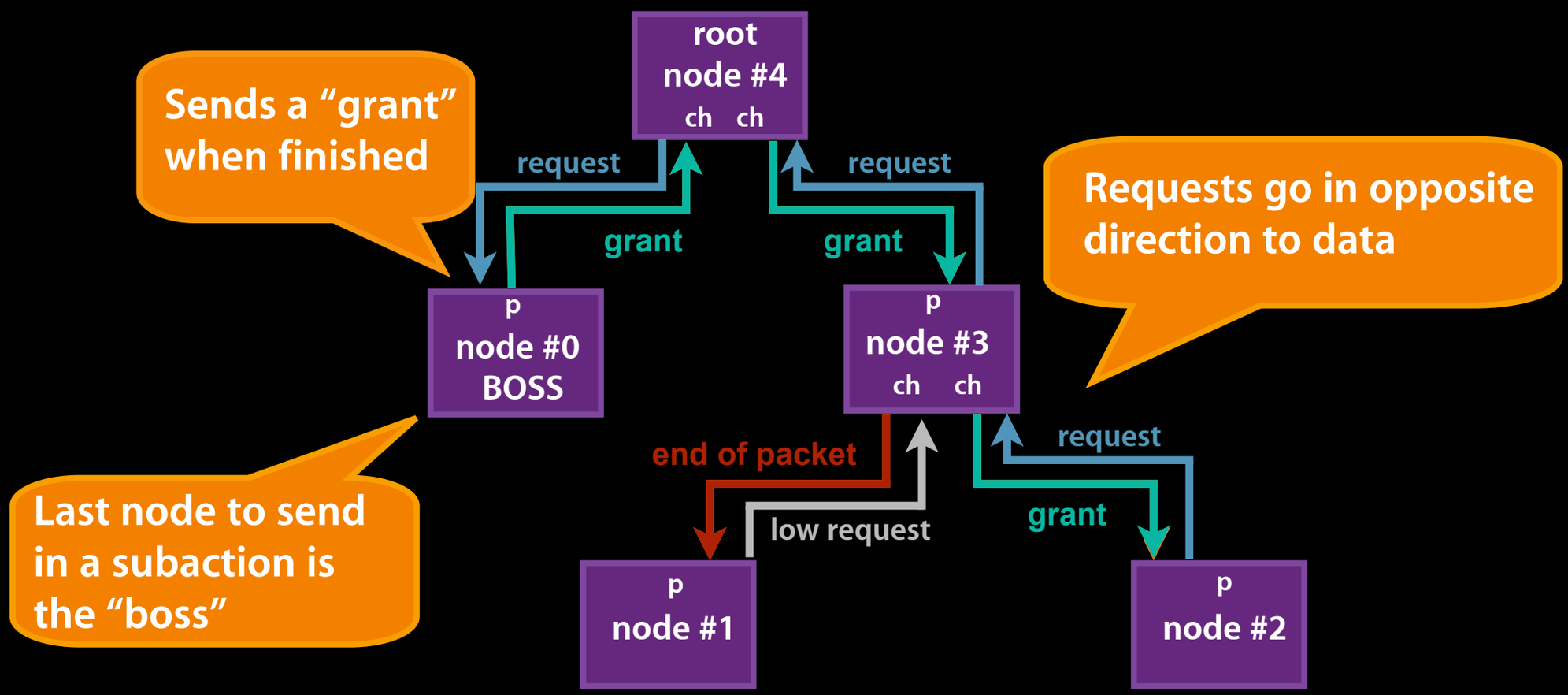
Beta mode efficiency:

BOSS Arbitration

- Legacy 1394 alternates between data transmission and arbitration
  - Arbitration depends on round-trip transmission time
  - Not scalable, so proportionately worse for higher speeds
  - Becomes much more significant with long distances
- 1394b uses overlapped pipelined arbitration
  - Scheme known as BOSS
- The BOSS is the currently transmitting node and decides who should transmit next
  - Explicit decision at the end of each subaction
  - Immediate decision saves the arbitration time

Overlapped Arbitration

With BOSS, 1394b exploits the dual simplex property



Gaps Are Removed!

- When the BOSS is finished transmitting, it knows where to send a grant
  - The end of packet sequence includes an optional Grant symbol
  - Each node repeating the end of packet sends the grant signal to the highest priority requester
- Similar process removes the need for an arbitration reset gap

Loop-Free Build Behavior

Will…

- Break all loops which can be removed by disabling a beta connection (FireWire 800 on both ends);
- Prune any branch containing a loop which can not be healed;
- Not interfere with operation of 1394a PHY's present on the bus;
- Not require any software intervention;
- Re-enable connections when disconnect removes loop threat;
- Not interfere with ability of software to determine the network topology and link speeds

But…

- It is non-deterministic (loop not broken in same place each time)

Hybrid Bus Operation

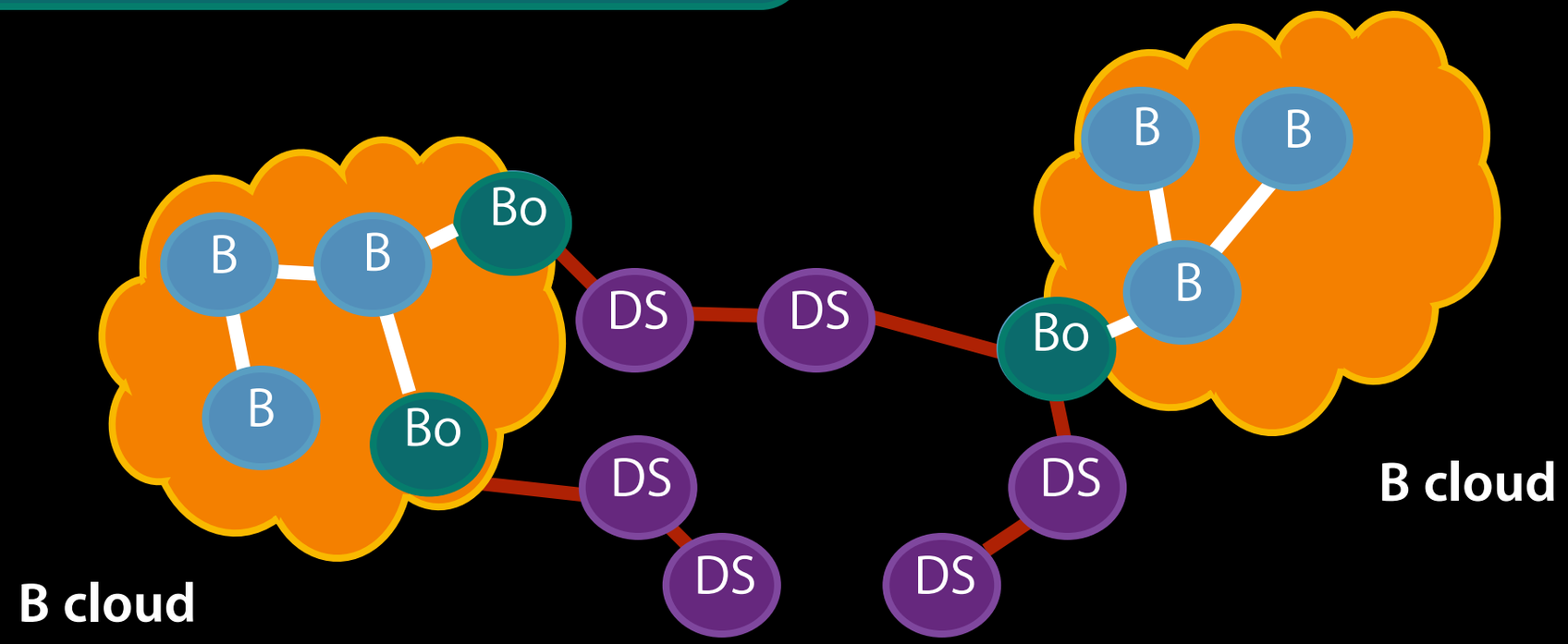
- 1394b is fully backwards compatible
- A port on a PHY may be implemented as
  - DS port
  - Beta-mode only port
  - Bi-lingual port
- Connector keying ensures that incompatible connections cannot physically be made
- A PHY may have any mix of ports operating in DS mode and Beta mode
- A PHY may have a B link, a Legacy link or no link

Hybrid Bus Operation (Cont.)

- A hybrid bus is one which contains DS (legacy) connections, and/or one or more Legacy link devices (as well as connections operating in Beta mode)

Border nodes connect between Legacy ports and links and 1394b Beta ports and links

Devices communicating via Beta-mode connections group themselves into B clouds



Hybrid Operation: Summary

- No restrictions on mixing Legacy nodes and 1394b nodes, beyond those inherent in the particular PHY chip implementation
  - If the user can plug it together, then it works
- Traffic within a B cloud can exploit full benefit of boss arbitration and more efficient packet formats
  - And Beta-only nodes are significantly simpler
- DS traffic operates as normal, with suitable gap times to ensure that all DS nodes can transmit each isochronous interval and in each fairness interval
  - Existence of more efficient Beta mode operation is totally transparent

Improved Connector

New connector needed for higher data rates

- So let us make everything better
  - Much better shielding and signal isolation
- Designed for both CE and PC worlds
  - Only slightly larger than existing 4-pin connector
  - Carries power to support PC peripherals

Keying to ensure compatibility

- Beta mode signaling is never used on a Legacy connector
- Simplifies backwards compatibility

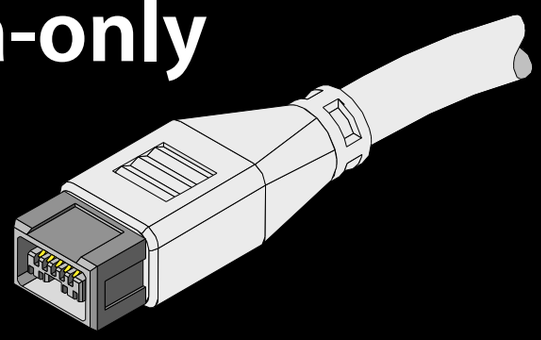
Two variants

- Bilingual connector—accepts Bilingual plug or Beta plug
- Beta connector—only accepts Beta plug

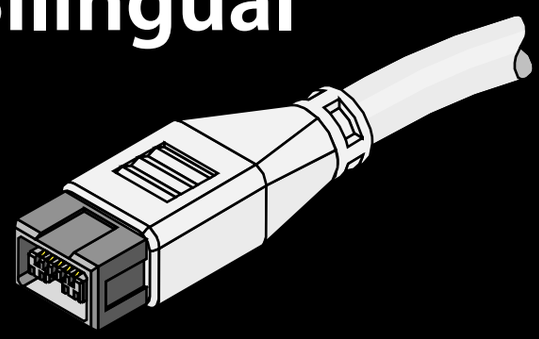
Bilingual and Beta Connector Plug and Socket

- 9 pin
  - Includes power
  - 2 extra pins for signal integrity
  - Validated to S3200 in the lab
  - One pin reserved for future use
- Small size—mating interface 8mm x 5mm

Beta-only



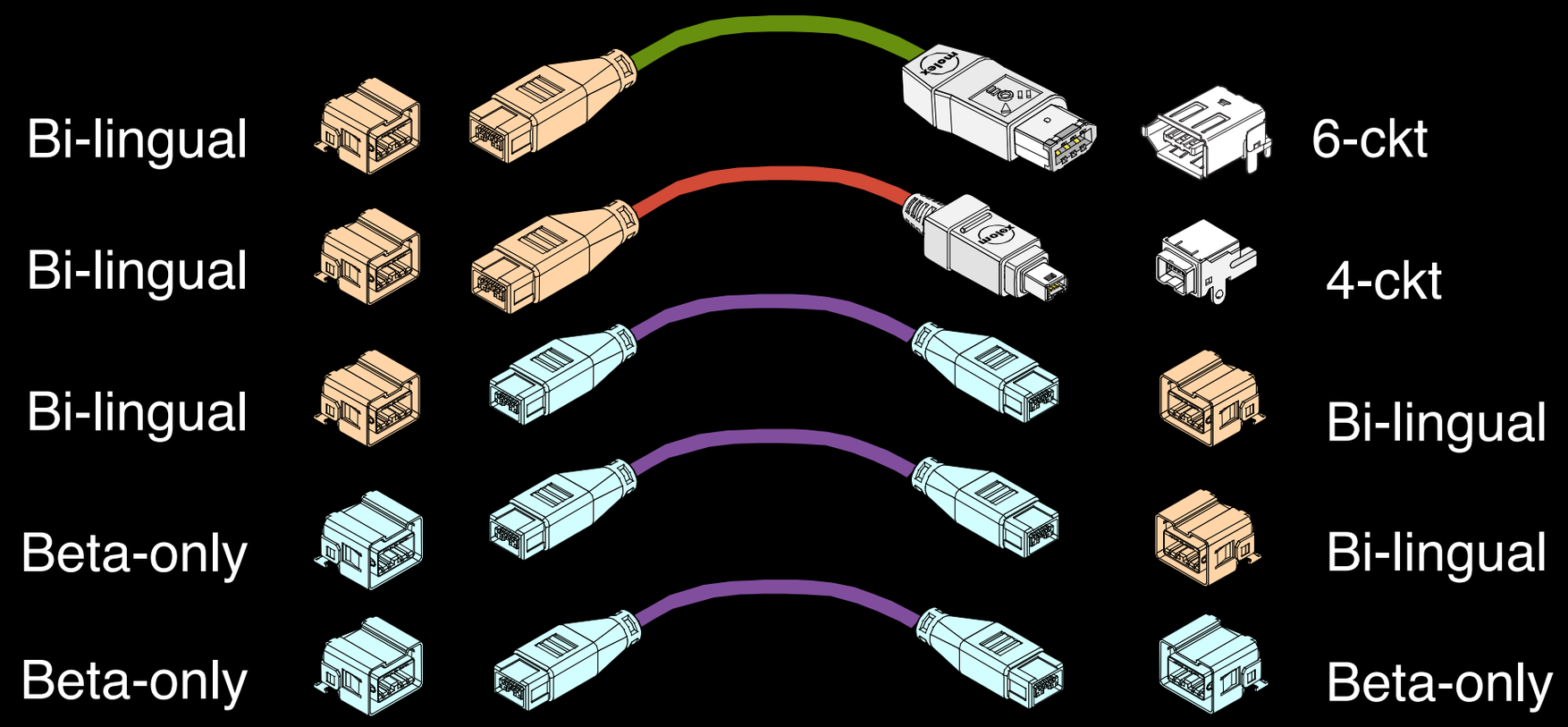
Bilingual



Three Cable Assemblies

Legacy mode cables
(prevents DS to Beta-only connection)

Bilingual to 6-ckt DS	(carries power)
Bilingual to 4-ckt DS	(no power)
Beta mode cable	(also used for bilingual to Beta)



Longer Distance

- General goal is 100m per hop
  - Input from VESA Home Network committee
- Unfortunately, longer distance requires new media
  - Cat-5 unshielded twisted pair for S100 and S800
    - Same cable as 10BASE-T, 100BASE-T, 1000BASE-T Ethernet
  - Plastic Optical Fiber (POF) for S200
    - S400 now available
  - Multi-mode glass fiber for higher speeds
    - Road map from S400 all the way up to S3200

Media Summary

	Reach	S100	S200	S400	S800	S1600	S3200
UTP-5	100m	●			● (S800 base-T)		
POF/ HPCF	100m	●	● (50m for POF)	● (new gen POF)			
50µm GOF	100m			●	●	●	●
STP (beta)	4.5m+			●	●	●	●
STP (DS)	4.5m+	●	●	●			

Demo

FireWire 800

FireWire Design Guide

Agenda

- What is the design guide
- Mechanical
  - Cables, connectors, connector orientation and placement
- Physical layer
  - EMC/EMI, port protection, isolation, power, layout concerns
- Higher layers
- Testing
- References

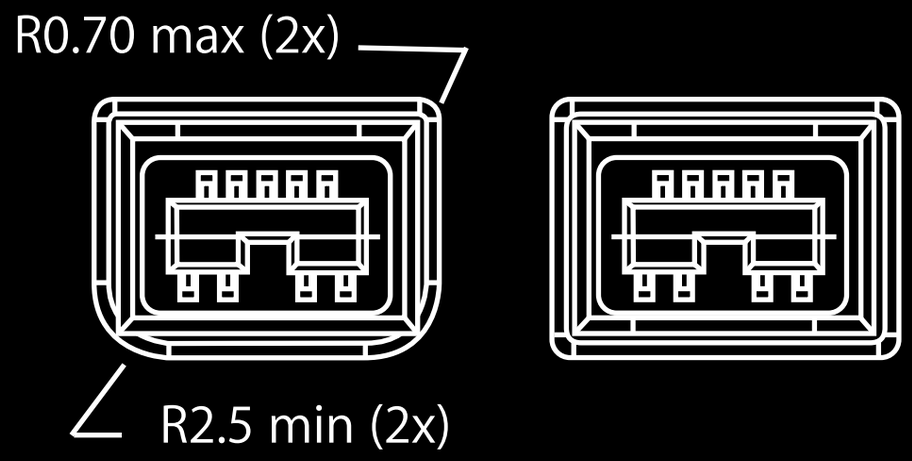
What Is the FireWire Design Guide?

- A single reference source for designers of FireWire-based systems
- Specific guidance through the web of 1394 standards
  - Compilation of the experience of Apple engineers, and those of many other companies as well
- Comprehensive listing of design resources
  - Application notes from component vendors
  - Presentations and papers from the 1394 Trade Association
  - Web-linked where possible
- Will be published both as paper and a web site
- This is the second iteration
  - Paper will be published at 1394 TA meeting in July

Connectors

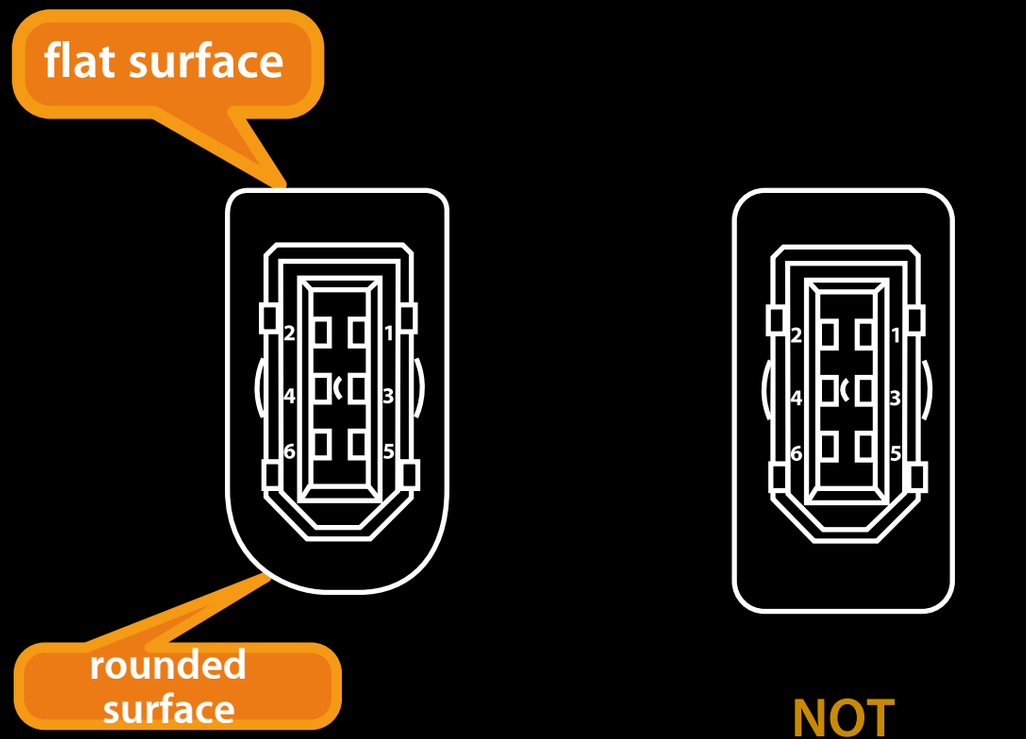
- Use the 6 (or 9) pin connector if at all possible
  - Much more rugged
  - Preferred by users
  - Can carry power
- Socket must resist backwards insertion
  - No split at narrow end
  - Enclose socket with sleeve
    …or part of external case or bulkhead
  - Keep socket from expanding with attempted backwards connection

Plug Overmold



Recommended

NOT
Recommended



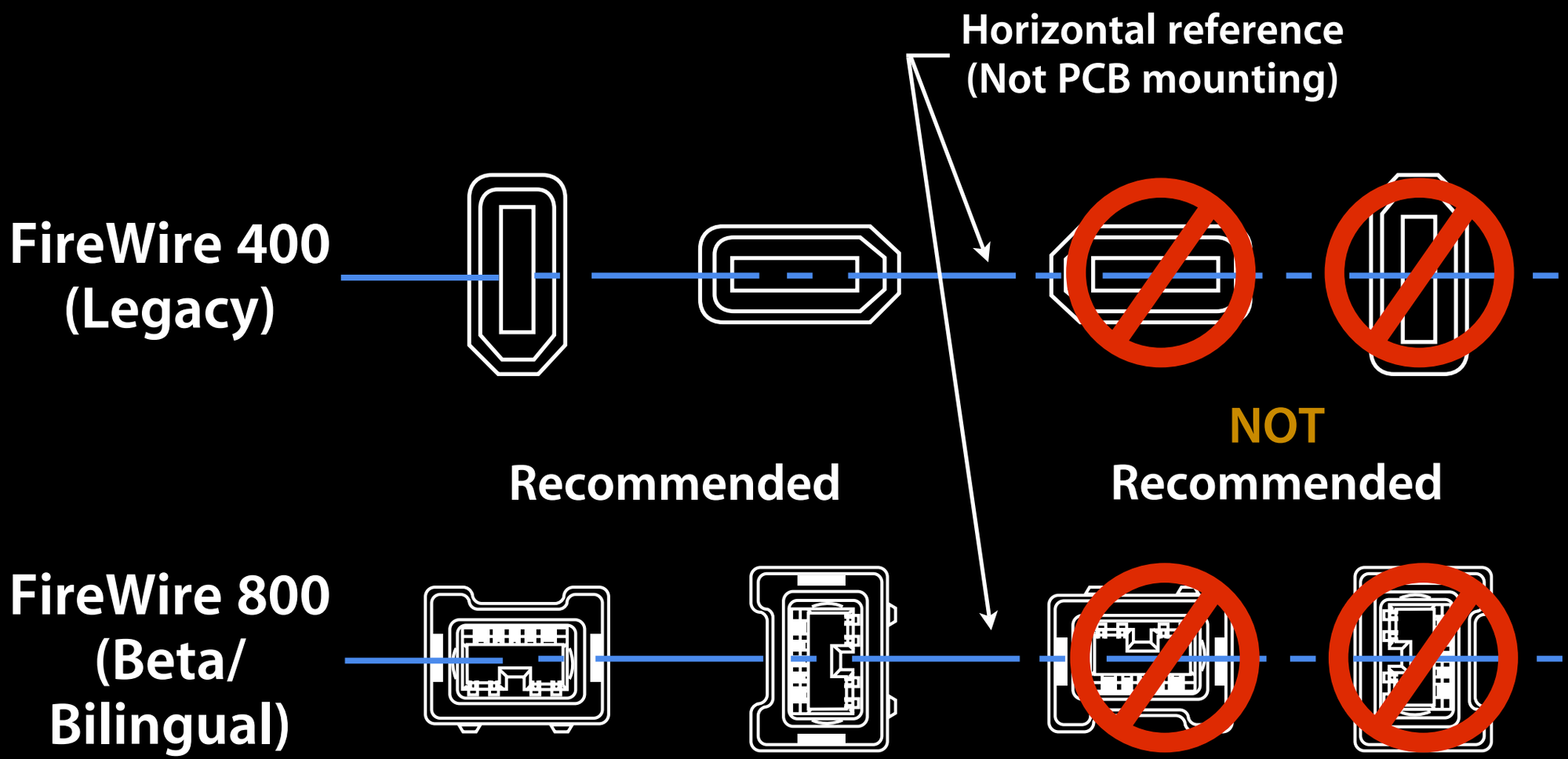
Recommended

NOT
Recommended

- Connector overmold should have standard orientation cues
- Where should I put the thumb?
  - Flat surface corresponds with flat surface on narrow axis of FireWire 400, insertion key of FireWire 800
  - Round surface corresponds with angled surface on narrow axis of FireWire 800, insertion key of FireWire 800
- Helps prevent attempted backwards connection

Connector Orientation

- Sockets should be placed so that thumb part of plug is on top or on the left (as viewed looking at the bulkhead from the outside)



Connector Placement

- Connectors attached to a single PHY must be close together
  - Connectors, PHY, protection and termination components for a single port best seen as a lumped circuit
  - Min rise time is 0.5ns…implies 1GHz waveforms!
- If both front and back panel connectors desired in a physically large device, then strongly consider separate PHYs for front and back
  - Xserve does this (two PHYs and one Link)

PHY ICs

- Use up-to-date parts!
  - More interoperable
  - Much lower power
- 1394a designs are a requirement for FireWire 400
- 1394b is evolving, use latest parts possible

Power

- Be familiar with 1394 TA Power Specifications
- Major system controllers (CPUs, TVs) should be power producers
  - NOT expensive, major user convenience
  - All Macs are power producers, at least 7W
- All peripheral devices using 5W or less should be bus powered
  - Minimize power bricks and wall warts
  - Consider using FW power to charge batteries for docking devices (iPod, cameras, etc.)

Be Aware of Voltage and Power Limits!

- 1394 standard calls for 8-33V, 1.5A max
  - iBooks typically provide 9-13V, 7W max
  - PowerBooks typically provide 12-16V, 7W max
  - iMacs (LCD) provide 12V, 6-8W max
  - iMacs (CRT) and eMacs provide 15-20V, 9W max
  - Pro desktops provide 14-28V, 15W max
- Power providers must limit current outrush
  - Hot-plugged power-sinking devices may have very low impedance as power supplies charge up

    …and, of course, there can be a short
  - Do not use replaceable fuses; use self-resetting current protection devices (e.g., PTC) or active current limiters

Isolation

- Only needed for exceptional environments
  - Long cables/“challenging” grounding/multiple nodes with high power requirements
- If isolation is required:
  - Use 1394b beta only connections
    - FireWire 800 cable for short distances
    - Category 5 or optical fiber for long distances
  - Do not use FireWire 400
    - Possible, but expensive to make work

Shielding

- Cable shield should be AC isolated from VG/PHY ground at connector
  - Cable shields pick up electrostatic charge from person plugging in cable
  - Shields pick up environmental noise; needs to be routed away from sensitive PHY receiver
  - Very difficult for 4 pin systems (The shield is used for return of the common mode speed signals)
- Cable shield should be DC connected to VG/PHY ground
  - Helps prevent PHY failure if VG connection fails (bad/dirty connector)
  - Best done at a single point to avoid loop currents
  - Ferrite between shield and VG OK

What About Protection?

- PHYs need to be protected from EMC
  - Very PHY-dependent, read application notes
- What about filters?
  - Best to design device to be very low noise
    - Then there is no noise to be sent out the cable
    - Layout rules will help keep radiation down
  - If this cannot be done
    - Carefully chosen common mode filter for TPA, TPB (too high impedance will block speed signaling)
    - NEVER put capacitors on TPx
    - Bead filter on VP is generally OK…do NOT put any filter on VG…it is the return path for speed signaling

PCB Layout Rules for Data Lines (TPx)

- No 90-degree corners
- No vias
- Equal distance for signals in a pair
- Equal distance for pairs in a port
- Minimize distance between connector and PHY
- Put termination as near PHY as possible
- Keep away from digital signals and clocks
  - Also from switching power supply
- Read and learn about high speed circuit design!

Higher Layers

- PHY-Link interface, Link IC and firmware issues will be discussed in later versions of the design guide
  - Watch for them!

Testing

- 1394 TA is starting testing for compliance and interoperability
- If you want the “real” FireWire mark, you will have to pass the test
- Tests conducted by independent 3rd party
  - The 1394 TA has contracted Quantum Parametrics (QP) to provide testing services for first six Logo Program Workshops
- This is important!

References

- Application notes from TI:
  - EMI Board Design and Layout Guidelines: slla117
  - Layout app note: slla020a
  - Crystal Selection app note: slla051
  - PHY FAQ: slla087
  - PHY as a repeater: slla016a
  - Development of a 1394 camera: slla086
- Applications notes from Agere:
  - FW323/FW322 Hardware Implementation Design Guideline, Revision 2: AP00041-02

FireWire 800 Software

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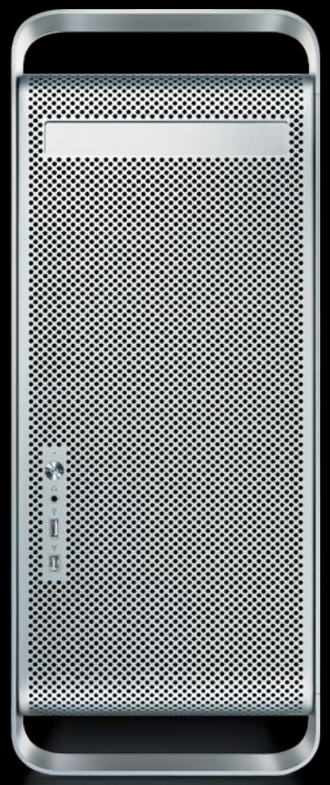
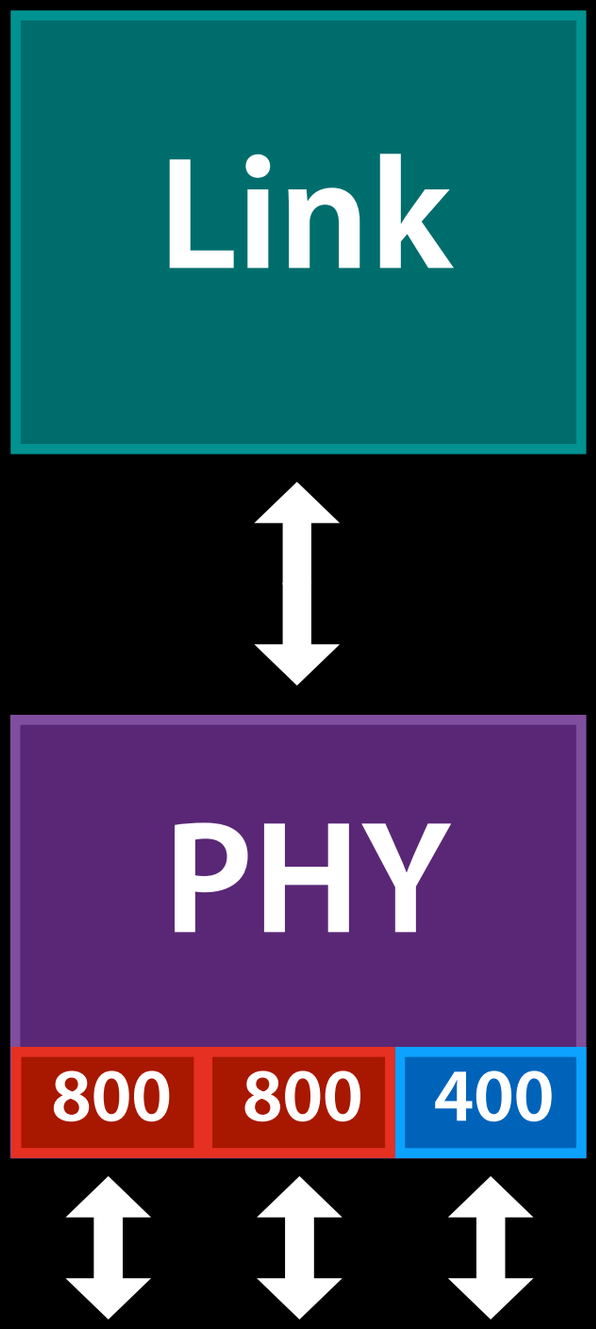


Software Support

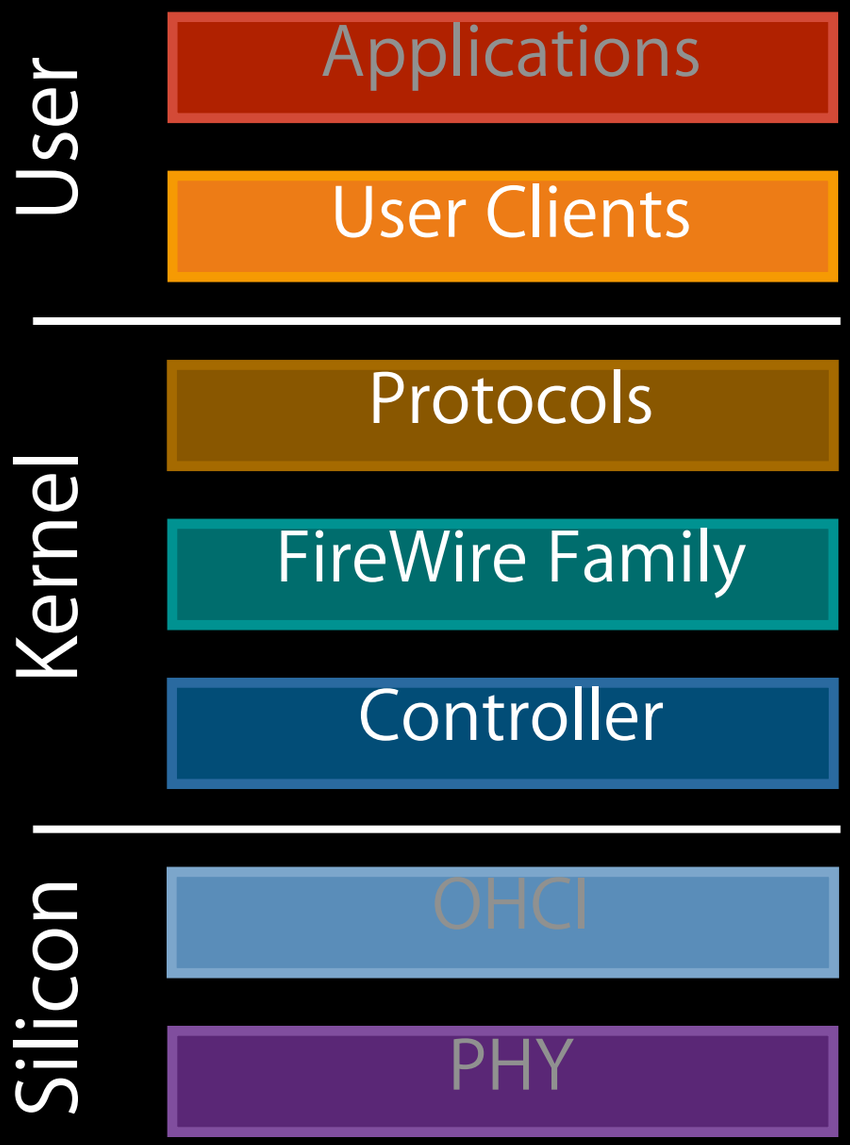
- Mac OS X 10.2.4 and later supports Apple's FireWire 800 ports
  - Power Mac G5
  - 17-inch PowerBook G4
  - Xserve



Inside a Mac

- The FireWire PHY knows which ports are FireWire 800 (9-pin) and which are FireWire 400 (6-pin)
- If your FireWire 800 products have a mix of connectors, be very careful to configure the PHY accordingly
  - Do not allow 800 Mbps on 6-pin sockets or cables

Mac OS X FireWire



- Service layers in kernel
  - OHCI
  - Family
  - Protocols (SBP, AVC, IP)
- User Clients
  - Application access
  - User-space drivers/plug-ins

Mac OS X Changes for FireWire 800

- New speed code (3) for 800 mbps
- New topology analysis for 1394b nodes
  - Each port may support a different maximum speed
  - e.g., Power Mac G5 has 1 x FireWire 800 + 2 x FireWire 400
- Few other changes
  - SBP-2 understands higher speed codes
  - Most drivers do not need to do anything different for FireWire 800

Developer Changes for FireWire 800

- Devices
  - Use FireWire 800 Link and PHY silicon
  - Use correct 9-pin socket (Bilingual)
  - Configure PHY ports correctly
- Software
  - Mac OS X selects best asynchronous packet speed for you
  - Isochronous drivers (e.g., IIDC/“DCAM”) may need to know about S800

Boot ROM

- Macs with FireWire 800 ports can
  - Boot from FireWire 800 devices
  - Boot from disks connected through FireWire 800 hubs
  - Run Target Disk Mode over FireWire 800

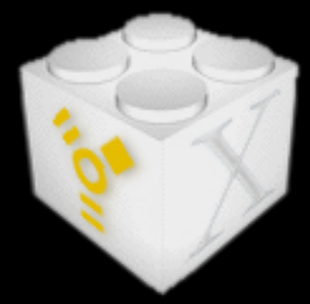
What Else Is New?

- FireWire in-depth session discussed
  - TCP/IP on FireWire
  - SBP-3 Support
  - Isochronous transfer with DCLs
  - Improved DCL services
  - AVC Target services

FireWire Resources

Software Development Kits

- FireWire SDK 16 for Mac OS X
  - Sample code
  - Tools, utilities, and test applications
  - Pre-release FireWire components (sometimes)
  - Instructions, notes, documentation, links
- Free public download



http://developer.apple.com/sdk

FireWire Reference Platform

- FireWire service and driver stack for embedded use
  - Fully independent of Mac OS X FireWire
- Suitable for single or multiple function devices
  - Camera, television, set-top box, printer, etc.
- Modular architecture supports common protocols
  - SBP-2 Target and Initiator; many AVC command sets

http://developer.apple.com/firewire/platform

FireWire Developer Events

- Plugfests at Macworld and WWDC
- Developer Kitchens
  - 2–3 day workshop at Apple with FireWire engineers
  - Often held in conjunction with a new SDK
  - Located in Tokyo and Cupertino as needed
  - Contact Apple Developer Relations when ready
- 1394 Trade Association Interoperability Workshops

1394 TA Interop

- Formal testing three ways
  - Pairwise private tests
  - Official 1394 TA test suites
  - “Grand Melee”
- Four times each year
  - Tokyo, Taipei, USA x 2
- Open to non-members

http://www.1394ta.org

1394 Trade Association

- Industry group for promotion of IEEE 1394
- Hosts mailing lists, web site, and quarterly meetings for technical working groups and standards development
- Hosts interop workshops and developers conference
- Organizes PR activities and trade show exhibits
- Source of many FireWire specifications
  - AVC commands sets, IIDC camera, Automotive, Testing

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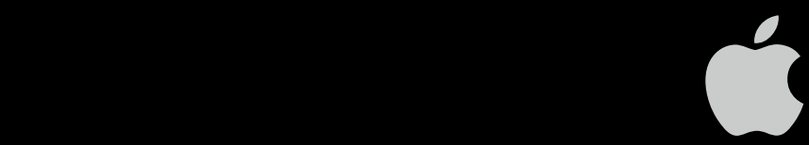


FireWire Tools

What Exactly Is a PHY?

- "PHY" is short for "PHYsical Layer"
- The PHY drives different voltages on the FireWire cable to make serial bits
- The PHY acts as a repeater, and performs arbitration
- Every node has a PHY—even hubs
- In comparison, the Link operates at a higher level
  - Packets, CRCs, DMA, Cycle Timer
  - OHCI: Open Host Controller Interface (in all Macs today)

1394a PHY Register Map

Address	0	1	2	3	4	5	6	7
0000_2	Physical_ID						R	PS
0001_2	RHB	IBB	Gap_count					
0010_2	Extended (7)			Total_ports				
0011_2	Max_speed				Delay			
0100_2	LCtrl	Contender	Jitter			Pwr_class		
0101_2	Watchdog	ISBR	Loop	Pwr_fail	Timeout	Port_event	Enab_accel	Enab_multi
0110_2								
0111_2	Page_select				Port_select			
1000_2	Register0 *Page_select*							
⋮	⋮							⋮
1111_2	Register7 *Page_select*							

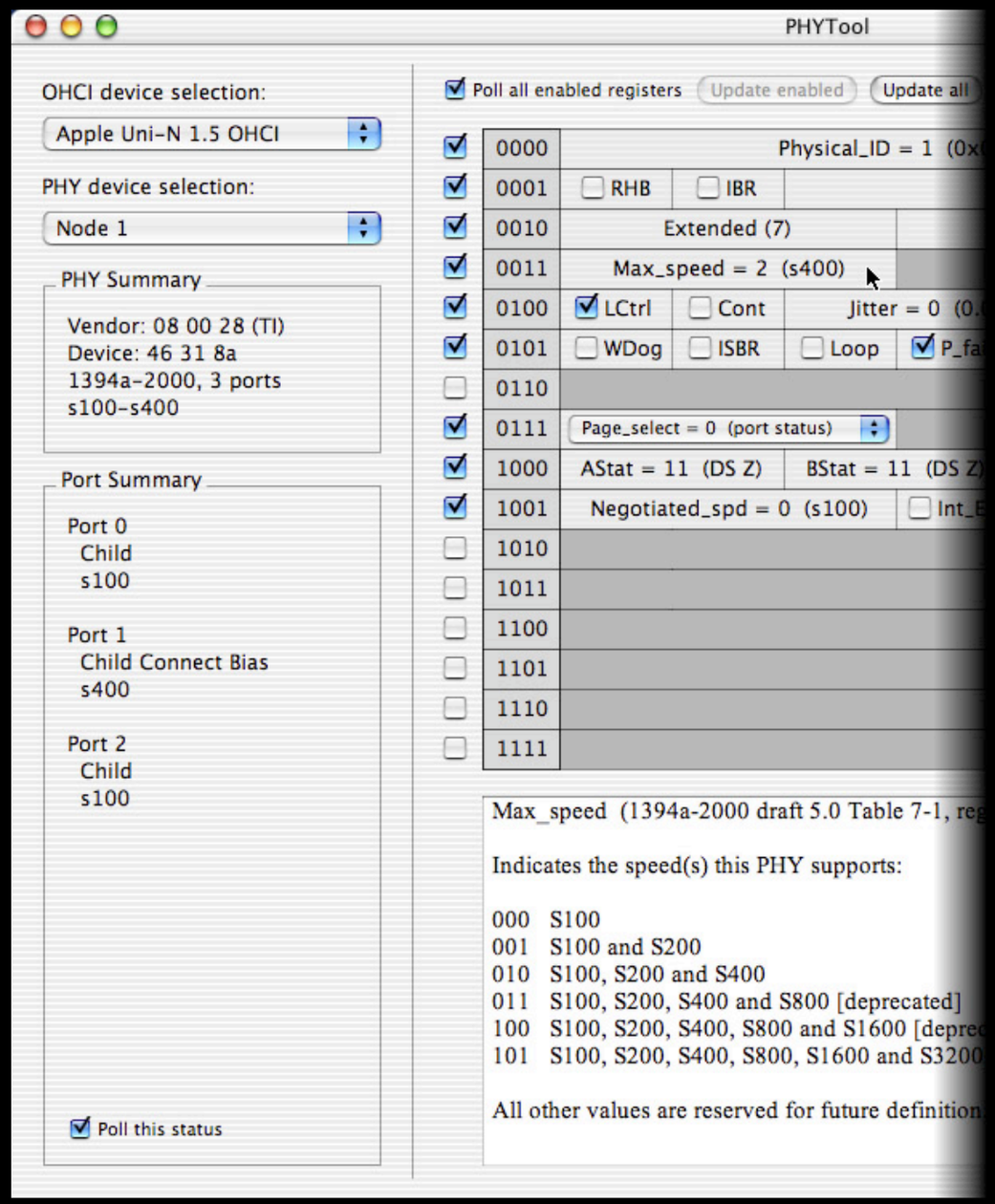
Figure 7-1: Extended PHY Register Map for the Cable Environment

1394b PHY Register Map

Address	0	1	2	3	4	5	6	7
0000_2	Physical_ID						R	PS
0001_2	RHB	IBB	Gap_count					
0010_2	Extended (7)			Total_ports				
0011_2	Max_speed			Enable_ standby	Delay			
0100_2	LCtrl	Contender	Jitter			Pwr_class		
0101_2	Watchdog	ISBR	Loop	Pwr_fail	Timeout	Port_event	Enab_accel	Enab_multi
0110_2	Max_legacy_path_speed			B_Link	Bridge			
0111_2	Page_select				Port_select			
1000_2	Register0 *Page_select*							
⋮	⋮							⋮
1111_2	Register7 *Page_select*							

Figure 12-1: Extended PHY Register Map for the Cable Environment

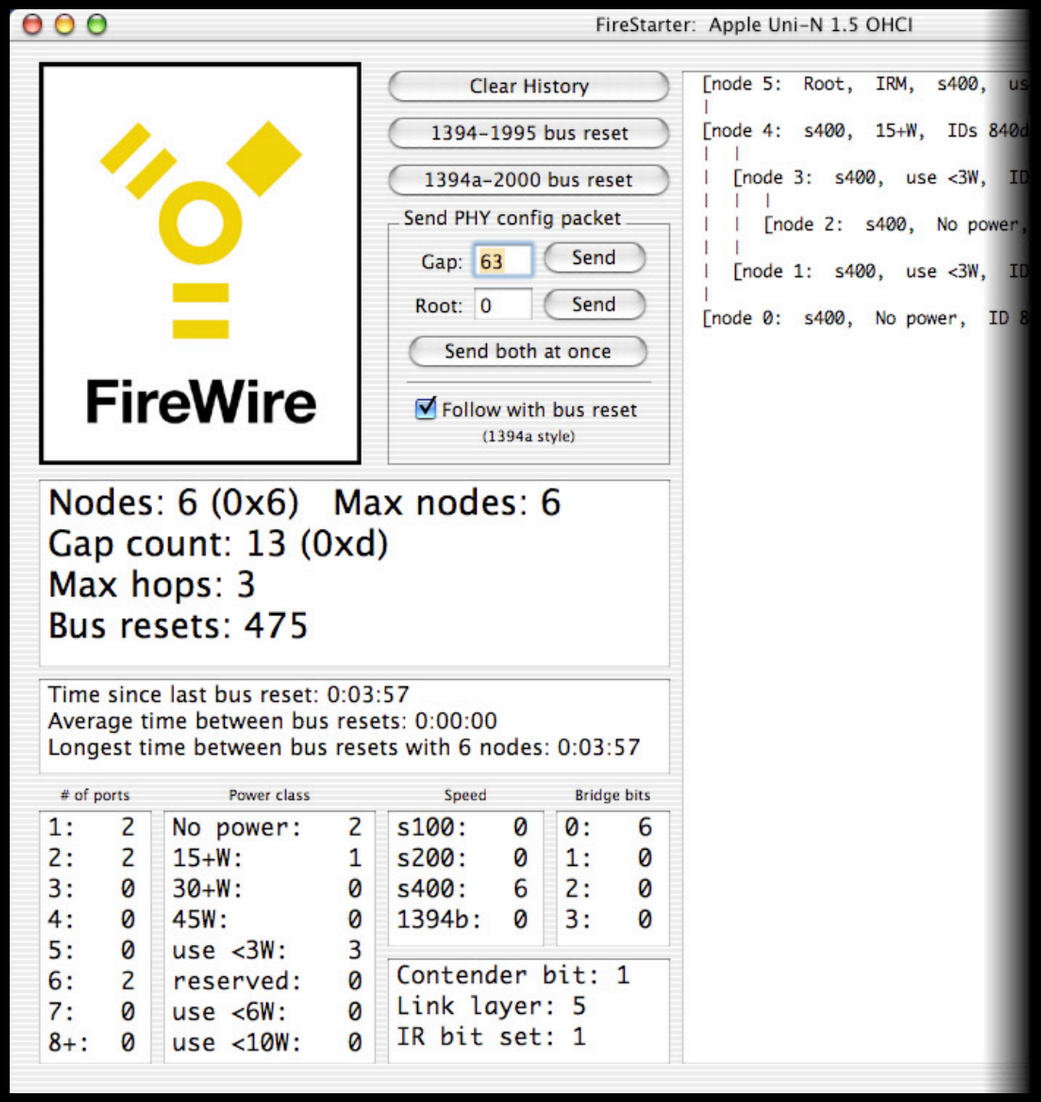
PHYTool



- Real-time PHY register browser and editor
- Integrated documentation
- Remote PHY access
- PHY and port status summary
- Works on all 1394 OHCI interfaces

Demo:
PHYTool

FireStarter



- Real-time topology display
  - Much faster than commercial analyzers
- Bus summary by node attribute
  - Speed, power, ports, etc.
- Bus configuration tools
  - Bus reset; Set root/gap
- Works on all 1394 OHCI interfaces

FireStarter: Apple Uni-N 1.5 OHCI

FireWire

Clear History

1394-1995 bus reset

1394a-2000 bus reset

Send PHY config packet

Gap: 63 Send

Root: 0 Send

Send both at once

Follow with bus reset

(1394a style)

```
[node 5:  Root,  IRM,  s400,  use <3W,  ID 854d8cd2]  *IR*
|
[node 4:  s400,  15+W,  IDs 840d816d 84817000]
|  |
|  [node 3:  s400,  use <3W,  IDs 834d849d 8381d000]
|  |  |
|  |  [node 2:  s400,  No power,  ID 824d8080]
|  |
|  [node 1:  s400,  use <3W,  ID 814d8460]
|
[node 0:  s400,  No power,  ID 804d8080]
```

Nodes: 6 (0x6) Max nodes: 6
Gap count: 13 (0xd)
Max hops: 3
Bus resets: 475

Time since last bus reset: 0:03:57
Average time between bus resets: 0:00:00
Longest time between bus resets with 6 nodes: 0:03:57

# of ports		Power class		Speed		Bridge bits	
1:	2	No power:	2	s100:	0	0:	6
2:	2	15+W:	1	s200:	0	1:	0
3:	0	30+W:	0	s400:	6	2:	0
4:	0	45W:	0	1394b:	0	3:	0
5:	0	use <3W:	3				
6:	2	reserved:	0				
7:	0	use <6W:	0				
8+:	0	use <10W:	0				

Contender bit: 1
Link layer: 5
IR bit set: 1

FireStarter: Apple Pangea OHCI

FireWire

Clear History

1394-1995 bus reset

1394a-2000 bus reset

Send PHY config packet

Gap: 63 Send

Root: 9 Send

Send both at once

Follow with bus reset

(1394a style)

Nodes: 63 (0x3f) Max nodes: 63
Gap count: 63 (0x3f)
Max hops: 11
Bus resets: 4650

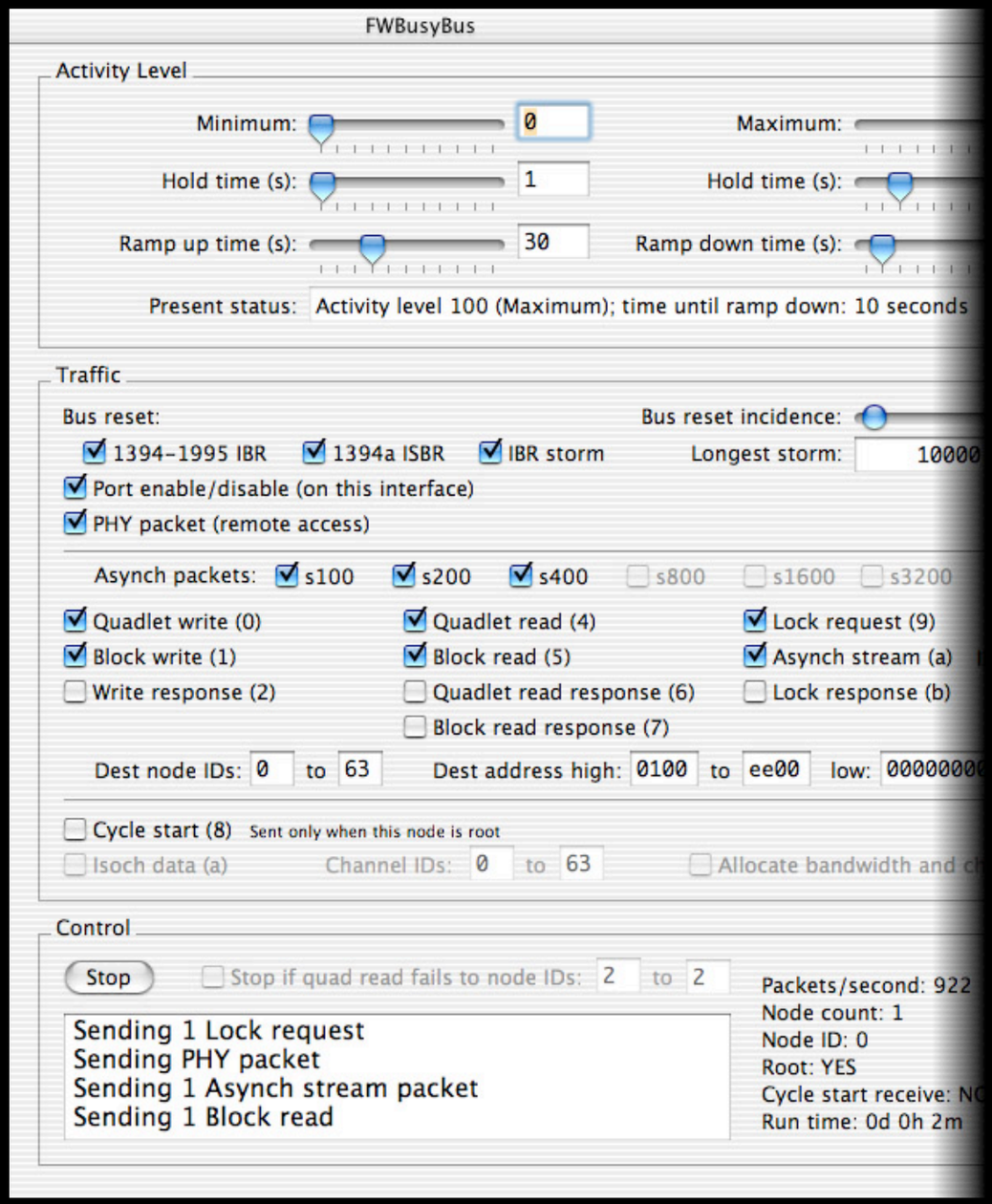
Time since last bus reset: 0:01:04
Average time between bus resets: 0:00:00
Longest time between bus resets with 63 nodes: 0:01:04

# of ports		Power class		Speed		Bridge bits	
1:	5	No power:	26	s100:	3	0:	63
2:	19	15+W:	2	s200:	1	1:	0
3:	33	30+W:	0	s400:	58	2:	0
4:	1	45W:	0	1394b:	1	3:	0
5:	0	use <3W:	26				
6:	5	reserved:	3				
7:	0	use <5W:	0				
8+:	0	use <9W:	6				

Contender bit: 14
Link layer: 42
IR bit set: 1

```
[node 62 (3e): Root, IRM, s200, No power, ID be7f48d4]
[node 61 (3d): s400, 15+W, ID bd7f81ec]
|  [node 60 (3c): s400, use <3W, IDs bc7f84f9 bc83f000]
|  |  |  |  |  [node 59 (3b): s400, use <9W, ID bb3f876c]
|  |  |  |  |  [node 58 (3a): s400, use <9W, ID ba3f8764]
|  |  |  |  [node 57 (39): s400, use <3W, ID b97f8460]
|  |  |  [node 56 (38): s400, use <3W, ID b83f84ec]
|  |  |  |  [node 55 (37): s400, No power, ID b77f8094]
|  |  |  [node 54 (36): s400, No power, ID b67f8890]
|  |  [node 53 (35): s400, No power, ID b57f80b4]
|  |  [node 52 (34): s400, No power, ID b43f80e4]
|  |  [node 51 (33): s100, No power, ID b37f0880]
|  [node 50 (32): s400, 15+W, IDs b23f81ed b283f000]
|  |  |  |  |  [node 49 (31): s400, use <3W, IDs b13f84bd b183f000]
|  |  |  |  |  |  |  |  |  [node 48 (30): s400, No power, ID b07f8080]
|  |  |  |  |  |  |  |  [node 47 (2f): s400, use <3W, ID af3f8494]
|  |  |  |  |  |  |  [node 46 (2e): s400, RESERVED, ID ae3f85d8]
|  |  |  |  |  |  |  [node 45 (2d): s400, use <3W, ID ad3f849c]
|  |  |  |  |  |  |  [node 44 (2c): s400, No power, ID ac7f8094]
|  |  |  |  |  |  [node 43 (2b): s400, use <3W, ID ab3f84bc]
|  |  |  |  |  |  |  [node 42 (2a): s400, No power, ID aa7f8094]
|  |  |  |  |  |  [node 41 (29): s400, use <3W, ID a97f84e0]
|  |  |  |  |  |  [node 40 (28): s400, use <3W, ID a83f8cbc]
|  |  |  |  |  |  |  [node 39 (27): s400, use <3W, ID a77f8490]
|  |  |  |  |  |  [node 38 (26): s400, use <9W, ID a67f87b0]
|  |  |  |  |  |  [node 37 (25): s400, use <3W, ID a53f849c]
|  |  |  |  |  |  [node 36 (24): s400, No power, ID a47f8094]
|  |  |  |  |  [node 35 (23): s400, No power, ID a33f80bc]
|  |  |  |  |  |  [node 34 (22): s100, No power, ID a27f0880]
|  |  |  |  |  [node 33 (21): s400, No power, ID a17f80e4]
|  |  |  |  |  [node 32 (20): s400, No power, ID a07f8094]
|  |  |  |  [node 31 (1f): s400, use <3W, IDs 9f3f84fd 9f83e000]
|  |  |  |  |  |  |  |  [node 30 (1e): s400, use <3W, ID 9e3f84b0]
|  |  |  |  |  |  |  |  [node 29 (1d): s400, use <3W, ID 9d3f8c64]
|  |  |  |  |  |  |  [node 28 (1c): s400, use <3W, ID 9c7f8ce0]
|  |  |  |  |  |  |  [node 27 (1b): s400, No power, ID 9b7f8894]
|  |  |  |  |  |  [node 26 (1a): s400, use <3W, ID 9a7f84e0]
|  |  |  |  |  |  [node 25 (19): s400, use <3W, ID 997f84b0]
|  |  |  |  |  |  [node 24 (18): s100, No power, ID 987f0880]
|  |  |  |  |  [node 23 (17): s400, RESERVED, ID 973f85d8]
|  |  |  |  |  [node 22 (16): s400, use <3W, ID 967f8480]
|  |  |  |  [node 21 (15): s400, No power, ID 957f88b4]
|  |  |  |  [node 20 (14): s400, use <9W, ID 947f8760]
|  |  |  [node 19 (13): s400, use <3W, ID 937f84ec]
|  |  |  |  [node 18 (12): s400, No power, ID 923f80ec]
|  |  |  |  |  [node 17 (11): 1394b, use <3W, ID 917fc464]
|  |  |  |  [node 16 (10): s400, No power, ID 907f8094]
|  |  |  [node 15 (f): s400, No power, ID 8f7f8894]
|  |  [node 14 (e): s400, use <3W, IDs 8e3f846d 8e83f000]
|  |  |  |  [node 13 (d): s400, No power, ID 8d7f8892]
|  |  |  |  [node 12 (c): s400, use <3W, ID 8c7f84e0]
|  |  |  |  [node 11 (b): s400, No power, ID 8b7f8090]
|  |  |  [node 10 (a): s400, use <3W, ID 8a7f8478]
|  |  |  [node 9: s400, use <3W, ID 897f8490]
|  |  [node 8: s400, use <3W, ID 883f84ec]
|  |  |  [node 7: s400, No power, ID 877f8094]
```

FWBusyBus



- Traffic generator
  - Asynchronous packets
  - Bus resets and storms
  - Port enables and disables
- Automatic rate adjuster
- Speed selection
- Works on all 1394 OHCI interfaces

FWBusyBus

OHCI device selection:

Apple Uni-N 1.5 OHCI

PHY Summary

Vendor: 08 00 28 (TI)
Device: 42 42 96
1394a-2000, 1 port
s100-s400

Port Summary

Port 0
Child DIS
s100

Activity Level

Minimum: 0 Maximum: 100
Hold time (s): 1 Hold time (s): 20
Ramp up time (s): 30 Ramp down time (s): 10
Present status: Activity level 100 (Maximum); time until ramp down: 10 seconds

Traffic

Bus reset: Bus reset incidence: 5
1394-1995 IBR 1394a ISBR IBR storm Longest storm: 10000 microseconds
Port enable/disable (on this interface)
PHY packet (remote access)

Asynch packets: s100 s200 s400 s800 s1600 s3200

Quadlet write (0) Quadlet read (4) Lock request (9)
Block write (1) Block read (5) Asynch stream (a) IDs: 11 to 29
Write response (2) Quadlet read response (6) Lock response (b)
Block read response (7)
Channels will NOT be allocated

Dest node IDs: 0 to 63 Dest address high: 0100 to ee00 low: 00000000 to fffffffc

Cycle start (8) Sent only when this node is root
Isoch data (a) Channel IDs: 0 to 63 Allocate bandwidth and channel

Control

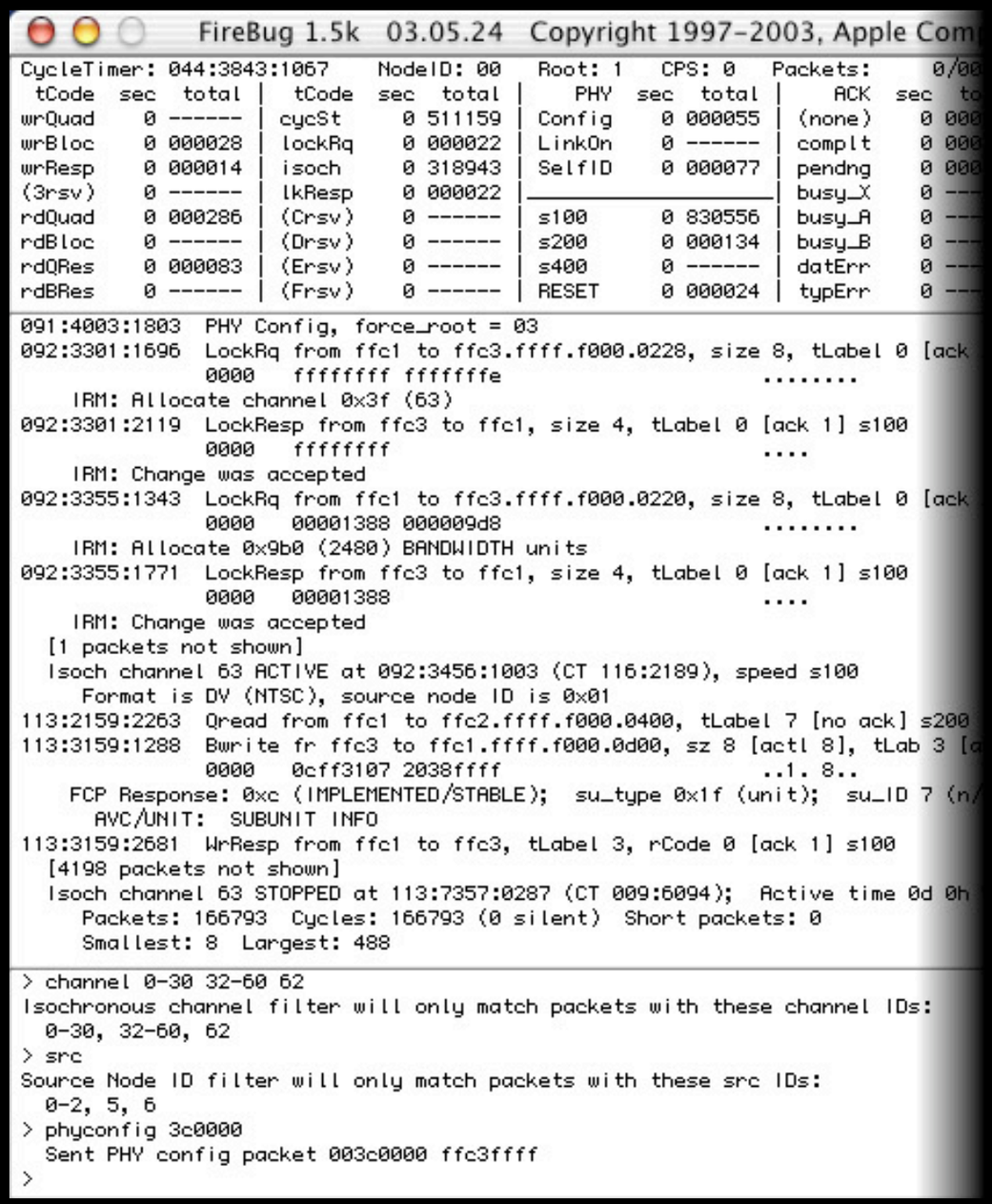
Stop Stop if quad read fails to node IDs: 2 to 2

Sending 1 Lock request
Sending PHY packet
Sending 1 Asynch stream packet
Sending 1 Block read

Packets/second: 922
Node count: 1
Node ID: 0
Root: YES
Cycle start receive: NO
Run time: 0d 0h 2m

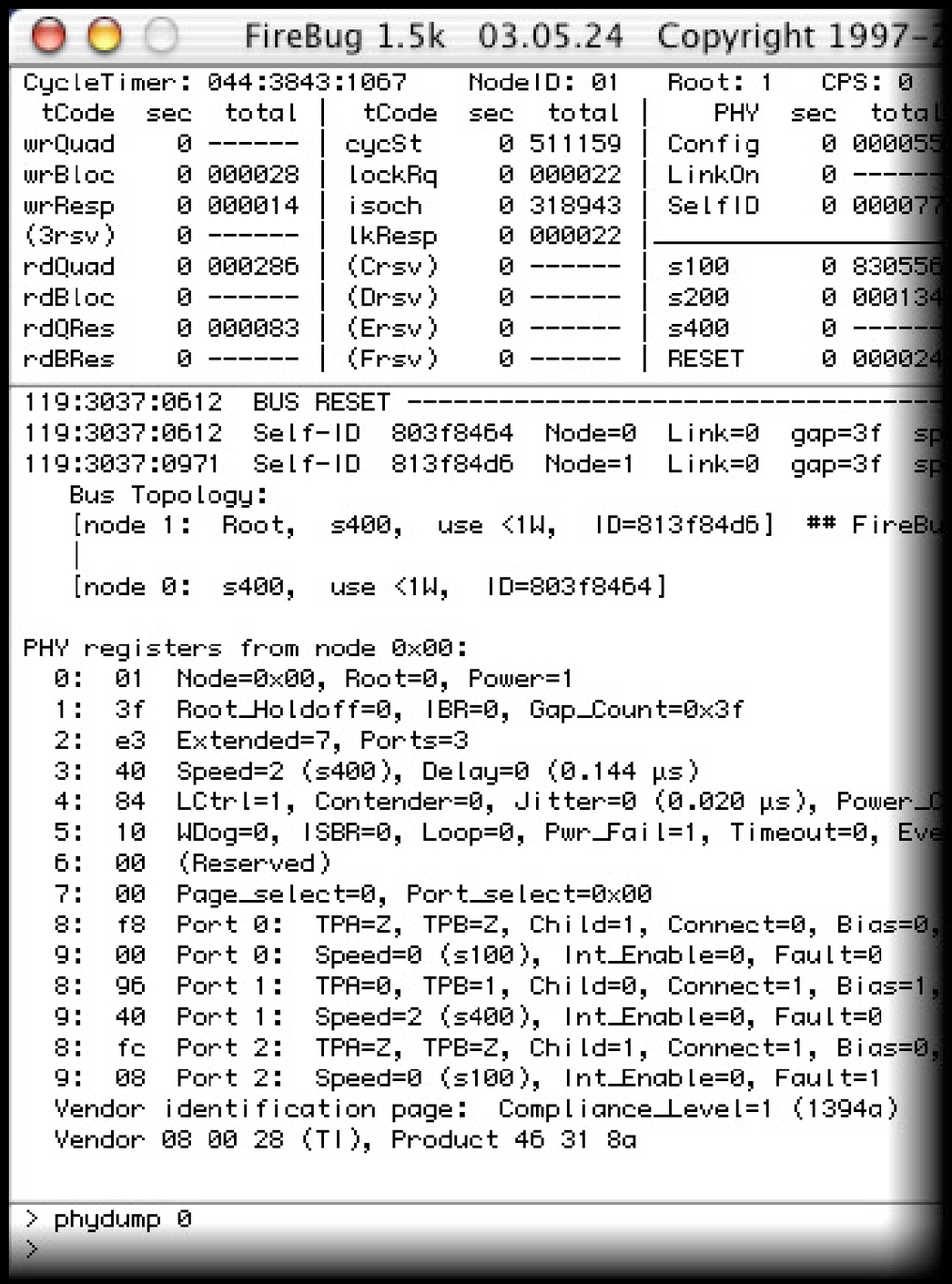
FireWire

FireBug



- Real-time packet snooper
  - Decodes all 1394 packets
  - Precision timestamps
  - Decodes SBP-2, AVC, IRM
  - Bus configuration services
- Requires TI PCI-Lynx interface
  - PCI or CardBus card
  - Built-in on some old Macs

FireBug Improved



- Better decode
  - More AVC commands
  - SBP-2 survives bus reset
  - PHY register dump
- New features include:
  - Node-ID filters
  - Isochronous summary
  - Dual-processor support

Standards and Specifications

Institute of Electrical and Electronics Engineers
http://www.ieee.org

1394 Trade Association
http://www.1394ta.org

International Standards Organization (ISO/IEC)
http://www.iec.ch

New Mac OS X FireWire Tools

- PHYTool (any OHCI)
- FireStarter (any OHCI)
- FWBusyBus (any OHCI)
- FireBug (still needs PCI-Lynx)

- All tools run on Mac OS X 10.2.5 and later
- All tools displace other FireWire drivers and services
- Be careful—make backups before using tools

Available Today

FireWire SDK 17 for Mac OS X
http://developer.apple.com/sdk

Please check FireWire mailing list for latest updates

Wrap Up

Roadmap

505 FireWire In-depth
Writing applications and drivers for FireWire

Marina
Tues., 5:00pm

FF006 FireWire and USB Feedback Forum
One-stop shopping for all your Serial Bus needs

North Beach
Wed., 3:30pm

508 FireWire Reference Platform
FireWire software for embedded systems

Marina
Thurs., 3:30pm

Plug and Unplug Fest
FireWire, USB, and Bluetooth

Apple Campus
Thurs., 7:30pm

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FireWire Reference Platform developer mailing list
www.lists.apple.com/mailman/listinfo/firewire-reference-platform
firewire-reference-platform@lists.apple.com

http://developer.apple.com/wwdc2003/urls.html

For More Information

Reference Library

Documentation

Working with FireWire Device Interfaces
http://developer.apple.com/techpubs/macosx/Darwin/IOKit/iokit.html

Software Development Kit

FireWire SDK 17 for Mac OS X
http://developer.apple.com/hardware/FireWire

Q&A

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http://developer.apple.com/wwdc2003/urls.html

WWDC 2003

Worldwide Developers Conference